bustion, in the coal basin of Decazeville and Aubin. His description also of the irreparable mischief wrought by the reckless destruction of forests, is well worth reading, for it must be remembered that the weird desolation of the limestone plateaux is a thing of comparatively recent date, and an indirect consequence of the French Revolution. Of the rock shelters of the "reindeer age" in the valley of the Dordogne and of other rivers, he has much to say, and of the dwellers in "holes of the rock" down to the present day; for these caves have been enlarged, or faced with masonry, or actually excavated, at various dates, and in some cases are still inhabited. Of the dolmens and other megalithic remains which are common on the plateaux region, Mr. Baring-Gould writes as one who has made a study of the subject. Perhaps some of his ethnological speculations may not meet with universal acceptance, but they are, at any rate, worth considering. The book contains many curious bits of folk-lore, as we might expect, and narrates sundry remarkable historical episodes in the mediæval struggle between France and England, and in the sanguinary conflicts of Huguenots and Romanists. A chapter is also devoted to the romantic, though often discreditable, story of Joachim Murat, who was born at a dirty little "bastide" of the same name on the Causse de Gramat, near the source of a tributary of the Lot. The book, in short, while it indicates the author's cultivated tastes and wide range of reading, directs the attention of travellers to a region of singular and varied interest, which hitherto has received but little notice even from the French themselves. It is only inadequately described in Reclus' great work, "Géographie Universelle." It has not, however, escaped the indefatigable emissaries of Baedekker, who gives, in the volume on Southern France, a succinct account of the district, evidently founded on personal knowledge. Armed with the little red book, and Mr. Baring-Gould's more bulky volumes, a rich reward undoubtedly awaits the visitor. The guidebook will direct his steps aright; Mr. Baring-Gould's pleasantly written and admirably illustrated volumes will give him abundant information about the chief points of interest, whether physical, archæological, or historical, and will be an unfailing resource during those hours of enforced leisure, which, on a journey, are apt to become tedious.

T. G. BONNEY.

OUR BOOK SHELF.

An Elementary Treatise on Theoretical Mechanics. Part I. Kinematics. Part II. Statics. By Alexander Ziwet, Assistant Professor of Mathematics in the University of Michigan. (London and New York: Macmillan and Co., 1893.)

AMERICAN mathematicians have always followed the system of the French and continental school, so that the progress of the American student in analytical development has not been arrested and stunted by the excessive reverence of the Newtonian methods prevalent in this country.

According to the continental system a student is introduced at the earliest possible stage to the Cartesian methods of geometry and to Leibnitz's extensions in the domain of the Differential and Integral Calculus; and then, even with a comparatively small equipment of analytical knowledge, hardly extending beyond an acquaintance with the notation, he is prepared to study and appreciate a work like the present; while the English student is kept back by clumsy antiquated methods, on the pretext of developing his geometrical and general reasoning powers.

This work is intended as an introduction to the science of theoretical mechanics, adapted to the particular wants of engineering students who, with the characteristic practical energy of their race and age, will not desire to be kept marking time over the rudiments.

The general treatment of the subject is elegant and complete, and valuable collections of illustrative examples are introduced at the different stages. One of these, however (ex. 6, § 276), caught the eye, as requiring amendment; as also the Fig. 29 of the catenary.

An old friend, the problem of the beam in a bowl—in other words, of a spoon in a teacup—given as ex. 20, § 151, deserves separate discussion, and a complete solution in the text.

The present opportunity is favourable for expressing to Prof. Ziwet the thanks of mathematicians in this country for his valuable Report of Prof. Klein's Lectures on Mathematics, called the "Evanston Colloquium," held before members of the Congress of Mathematics in connection with the World's Fair at Chicago, at Northwestern University, Evanston, Ill.

G.

By Order of the Sun to Chile to see his Total Eclipse, April 16, 1893. By J. J. Aubertin. Pp. 152. (London: Kegan Paul, Trench, Trübner, and Co., 1894.)

TWO years ago Mr. J. J. Aubertin, having seen a copy of NATURE for October 13, 1892, containing a letter on the then coming solar eclipse, went home and dreamed a dream. In his vision the Sun visited him and ordered him to gird up his loins, and go to the desert of Atacama and watch the eclipse. This brief explanation is necessary in order to account for the rather clumsy title of the book before us. Mr. Aubertin, regardless of the belief that dreams should be reversed, and that he was seventy-five years of age, travelled to Chile, and, meeting Prof. Schaeberle there, became one of the eclipse party. He was, however, more an interested layman than a scientific observer, and therefore his book is of very little value to astronomers. In fact, the book is chiefly taken up with tittle-tattle of interest to very few beyond the parties concerned. A picture of the corona, as seen by the author, is very pretty, and compares favourably with the impressions recorded by observers of the phenomena before photography monopolised the field as a coronal artist. But at the present time, the results of visual observations of the corona are regarded with suspicion, and rightly, for they never afford any very definite information as to the true form and structure of the sun's surroundings. However, Mr. Aubertin faithfully records what he saw, so his observation must be accepted. The book contains Prof. Schaeberle's photograph as a frontispiece.

Reise nach Südindien. Von Emil Schmidt. Mit 39 Abbildungen im Text. (Leipzig: Wilhelm Engelmann, 1894.)

HERR SCHMIDT'S book is a plain, straightforward narrative of a tour through Southern India, in the course of which he visited Madras, Travancore, made an excursion to Cape Comorin, proceeded by Trivandrum to Cochin, and thence by Coimbatore to the Anamalay Hills, going afterwards to the Nilgiris, and finishing at Calicut. The object of the journey was mainly to study the native peoples, and numerous ethnological photographs give a certain value to the book. There is, however, nothing new in the way of an important contribution to science in the work, which is most interesting as showing the impressions produced on an intelligent and observant German by a visit to Southern India. The style is lively, but perfectly serious, and cannot fail to be of much value in Germany, where it appears few books have been pub-

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lished dealing with the lighter aspects of Indian life. It is pleasant to note that Herr Schmidt found the English officials and planters everywhere very hospitable and cordial, ready to assist him in his inquiries as to the people, and able to give him much valuable information on the subjects which he was studying.

By Vocal Woods and Waters. By Edward Step. Pp. 254. (London: Bliss, Sands, and Foster, 1894.)

A RESURRECTION book, made up of papers originally contributed to *Good Words*, *Leisure Hour*, *Sunday Magazine*, *Silver Link*, and other periodicals. The author is well known as a close observer of nature, and he has the amount of poetry in his composition essential in a writer on popular natural history. The book is nicely printed and illustrated.

LETTERS TO THE EDITOR.

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Acquired Characters.

IN reference to the question as to how far the signification of the term "acquired characters" may usefully be extended beyond the precise limit given in Lamarck's two laws (quoted in my letter of November 15), or what phenomena may be brought into close relationship with those indicated by Lamarck, the following considerations, will, I think, be found useful.

Let us consider a relatively stable local "race" of some species of organism. The race is found to present a certain range of variation, but has an average character; and cases approximating to the average are so far more numerous than departures from it, that for our immediate purpose we may leave the aberrant individuals out of account. The average specific character is a matter which may be determined by measurement and weighing. It can be stated in numerical form as to length of such and such parts, breadth and depth of other parts, weight (*i.e.* amount) of pigment or other chemical product here or there. We know by experiment that these quantities can be altered in immature individuals *within limits* by changing the physical conditions in which the individual is placed. These physical conditions are (roughly speaking) such measurable quantities as those relating to temperature, light, mechanical strains, moisture, and varying amounts of chemical compounds or elements operating on the organism through its absorbing surfaces (respiratory organs, digestive organs, integument).

From such experiments we are led to conclude that without destroying the life of an individual many characters can be increased in quantity, but that there is a limit beyond which they cannot be so increased; and that many characters can be reduced in quantity in the same way in an individual without destroying its life, but that here also there is a limit. Hence it seems that we are justified in distinguishing the "potential" from the "actual" characters of an organism.

This *potentiality* of the individual is something inborn or congenital. On the other hand, the *actual* quantitative condition of the average characters of a naturally-occurring assemblage of individuals is necessarily to some extent the result of the operation of the measurable physical agencies which constitute the normal environment of the species or race. (The range of difference, it may here be noted, between the potential and the actual characters of a species as thus indicated, is found to differ very greatly in different species and in regard to different parts of the organism.) Thus then every individual exhibits certain quantitative characters, the amounts of which are *determined* by the operation on the individual of given and related quantities of external agencies. To a character thus quantitatively determined, some writers have extended the term "acquired character," inasmuch as it is not the congenital potential character in its purity (if such a thing were possible) which we thus contemplate, but the congenital character as moulded, increased, or restrained by surrounding conditions. But whilst I am very decidedly of opinion that a consideration of this moulding, expanding, or restraining influence of the normal environment is likely to throw important light upon the implications of Lamarck's doctrine, I agree most emphatically with Mr. Francis Galton in thinking that the use of the term "acquired characters" must be limited, as indicated by Lamarck's own statement, to characters, "which are regularly found in those individuals only which have been subjected to certain special and abnormal conditions" (to quote Mr. Galton's words). The word "acquired" was used by Lamarck, and should continue to be used as pointing to an acquisition, under *new* conditions, of *new* character or characters, distinct from the normal characters which form, as it were, the starting-point, however determined or brought into existence.

It is, however, true that the difference between the actual characters of an individual organism as compared with its potential characters—a difference the origin of which may be expressed by calling the former "responsive characters"—is of the same order whether the actual characters are determined in their amount by the normal environment of the race, or by abnormal quantitative changes of that environment.

And it seems to me, that in considering this we are led to the conclusion that the second law of Lamarck is a contradiction of the first. Normal conditions of environment have for many thousands of generations moulded the individuals of a given species of organism, and determined as each individual developed and grew "responsive" quantities in its parts (characters); yet, as Lamarck tells us, and as we know, there is in every individual born a potentiality which has *not* been extinguished. Change the normal conditions of the species in the case of a young individual taken to-day from the site where for thousands of generations its ancestors have responded in a perfectly defined way to the normal and defined conditions of environment; reduce the daily or the seasonal amount of solar radiation to which the individual is exposed; or remove the aqueous vapour from the atmosphere; or alter the chemical composition of the pabulum accessible; or force the individual to previously unaccustomed muscular effort or to new pressures and strains; and (as Lamarck bids us observe), in spite of all the long-continued response to the earlier normal specific conditions, the innate congenital potentiality shows itself. The individual under the new quantities of environing agencies, shows *new* responsive quantities in those parts of its structure concerned, new or "acquired" characters.

So far so good. What Lamarck next asks us to accept, as his "second law," seems not only to lack the support of experimental proof, but to be inconsistent with what has just preceded it. The new character, which is *ex hypothesi*, as was the old character (length, breadth, weight of a part) which it has replaced—a response to environment, a particular moulding or manipulation by incident forces of the potential congenital quality of the race—is, according to Lamarck, all of a sudden raised to extraordinary powers. The new or freshly-acquired character is declared by Lamarck and his adherents to be capable of transmission by generation; that is to say, it alters the potential character of the species. It is no longer a merely responsive or reactive character, determined quantitatively by quantitative conditions of the environment, but becomes fixed and incorporated in the potential of the race, so as to persist when other quantitative external conditions are substituted for those which originally determined it. In opposition to Lamarck, one must urge, in the first place, that this thing has never been shown experimentally to occur; and in the second place, there is no ground for holding its occurrence to be probable, but, on the contrary, strong reason for holding it to be improbable. Since the old character (length, breadth, weight) had not become fixed and congenital after many thousands of successive generations of individuals had developed it in response to environment, but gave place to a new character when new conditions operated on an individual (Lamarck's first law), why should we suppose that the new character is likely to become fixed after a much shorter time of responsive existence, or to escape the operation of the first law? Clearly there is no reason (so far as Lamarck's statement goes) for any such supposition, and the two so-called laws of Lamarck are at variance with one another. To push the matter further—in those cases in which experiment has been made, it has been found that a character acquired by an individual removed from the operation of a related condition normal to the race of which that in-individual is an example, is replaced by the old character when the old condition is restored in the environment of the offspring of that individual. No doubt I shall be challenged to

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